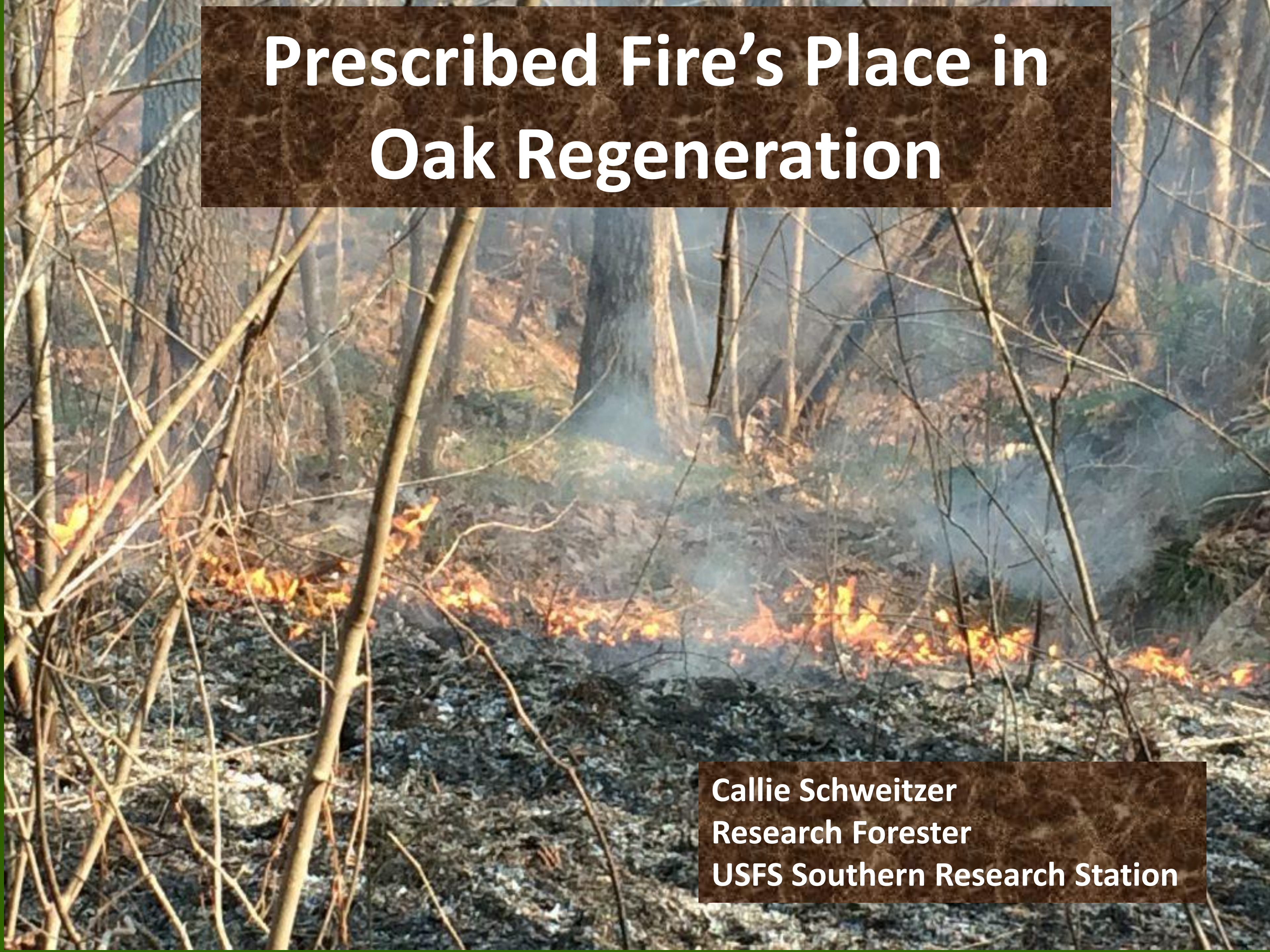


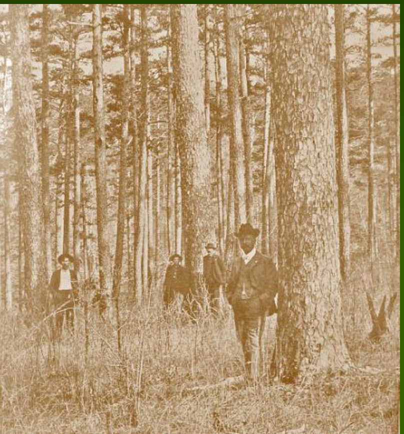
Prescribed Fire's Place in Oak Regeneration

Callie Schweitzer
Research Forester
USFS Southern Research Station

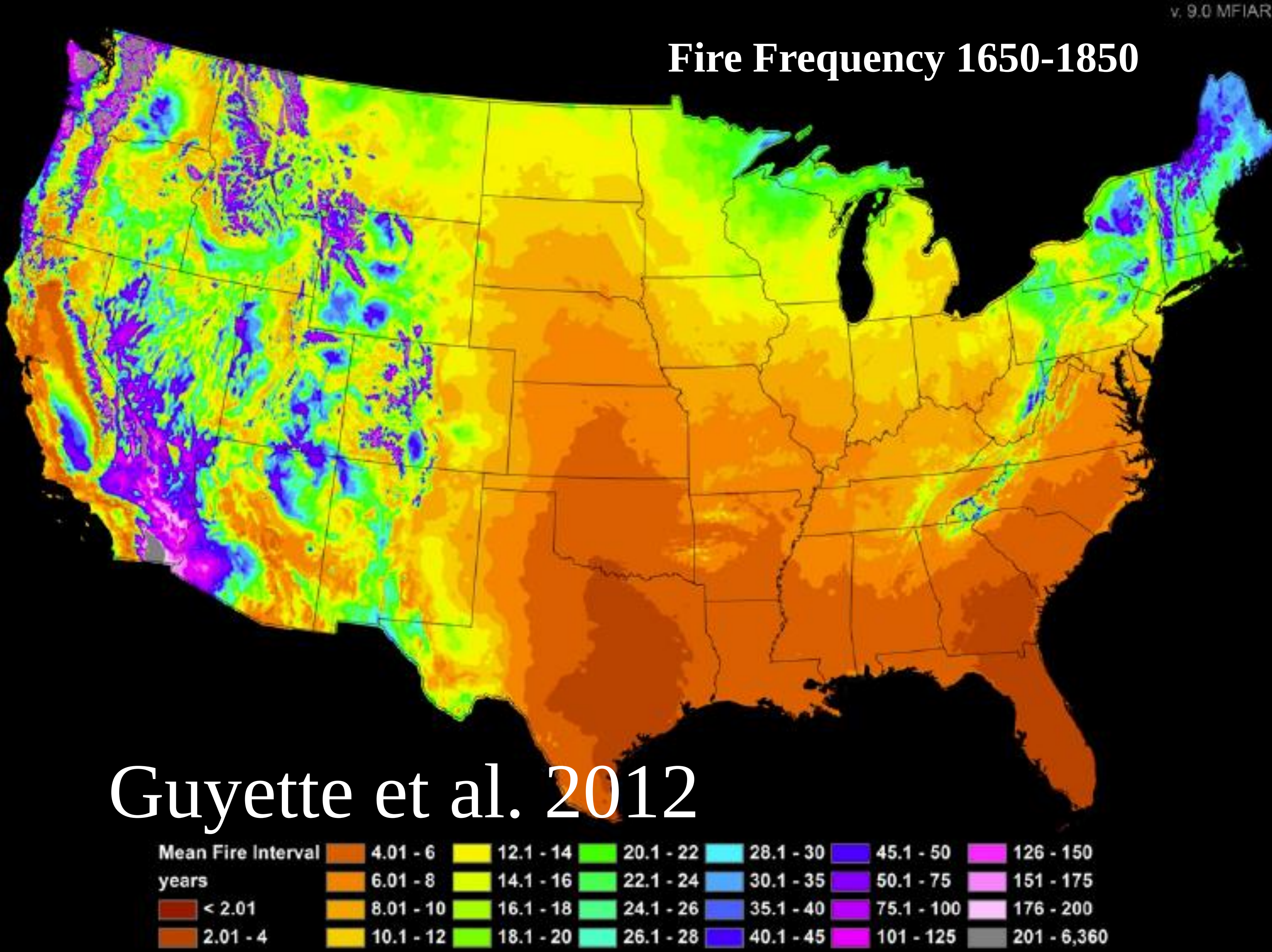
What’s up with eastern Oak forests?

- History and status
  - Disturbance regime changes
    - **Harvesting**
    - **Fire**
    - **Grazing/Browsing**
  - Loss of American chestnut
  - Age class shif
    - **Understory i tolerant**
- Why do we have a regeneration prob
  - Oak forests re reproduction
  - Absence of <u>la</u> reproduction
  - Probability of stump sprouting for large trees is low

Changes in land use history and the forests of today



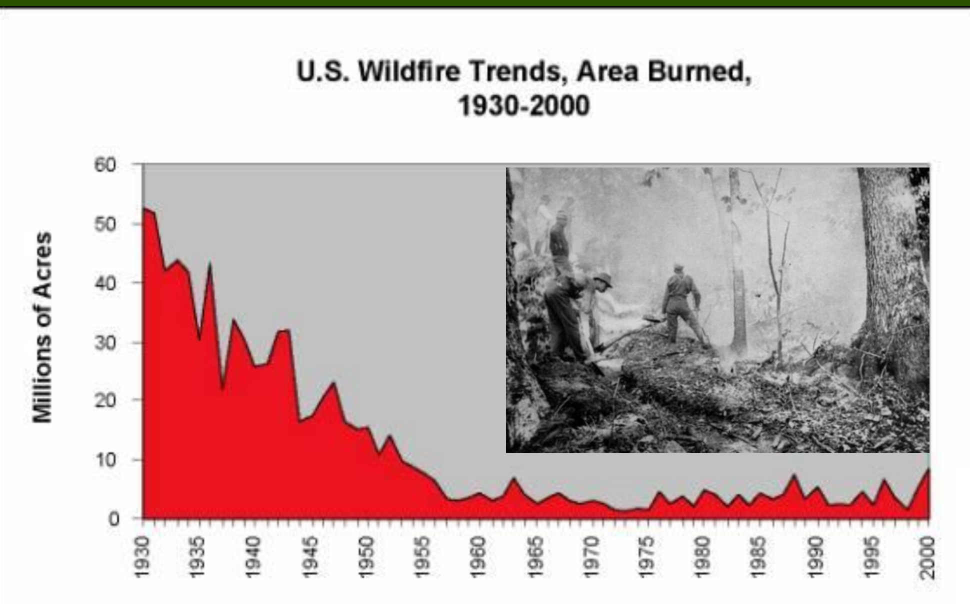
Fire Frequency 1650-1850



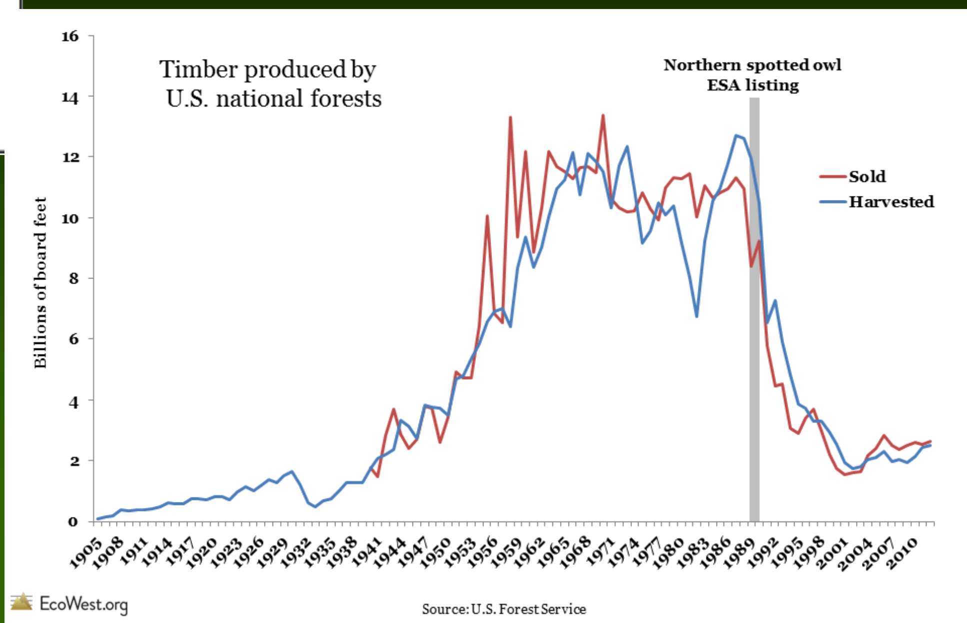
Guyette et al. 2012

Current Drivers of Landscape Character
Changing Management Policies and Practices

Fire Suppression

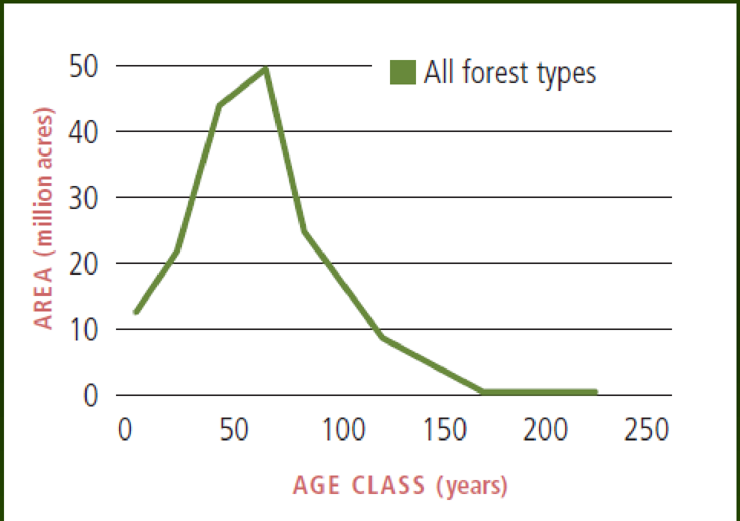


Timber Harvest on National Forests



Where are we today?

* Contemporary forests are ____________
* Homogenization of the forest landscape
* Loss of forest resiliency
* Need for active forest management to promote oak ecosystems and diversify the landscape



60 to 70% of eastern forests are 40 to 100 years old

Shifley et al. 2012

With developing shade tolerant understories
Dominated by woody species and shade tolerant forbs in the understory

Contemporary Upland Oak Forests

Overstory oaks mature 80 to 120+ yrs

Oak reproduction– advanced growth dependent

Oak advance reproduction is
absent or small (not competitive)

Midstory oaks scant or missing

Abundant shade tolerant species

OAK-FIRE HYPOTHESIS

- **Multiple fires can affect a fire-mediated shift from mesophytic species in favor of oak**
- **Oaks have characteristics that are more 'tolerant' to fire**
  - Thick bark (only when they get big enough)
  - Sprouting
    - Buds below ground and protected from fire
    - Allocate more carbon to roots, helps respond to top-kill

OAK-~~FIRE~~ Disturbance HYPOTHESIS

- Lack of disturbance (fire harvesting) has affected a disturbance-mediated shift away from xeric-phytic species
- Most if not all small hardwood seedlings will be top-killed by fire
- Most if not all small hardwoods will sprout after top-kill
- Change in disturbance=change in species assemblages
- EXAMPLE: Red maple sends up lots of sprouts
  - high photosynthetic capacity (more sprouts=more leaves)
  - Food energy used to grow taller and fatter
  - Outer sprouts act as sentinels

Why use fire?

- Restoring a process that has been lost/ restoration ecology
- Reduce fuels
- Create a habitat type that has been diminished- woodlands and savannahs
- Habitat heterogeneity (wildlife, resilience, forest health)
- As part of the oak regeneration process

Can we use fire to recruit small oak advance reproduction into more competitive positions?

Stand development considerations

Mature stands in the understory re-initiation stage

REGENERATION PROCESS

Stand initiation stage

Oaks are adapted to frequent mixed severity disturbances that create open environments

~20% full sunlight (under a canopy) favors oak over other species

30 to 50% full sunlight good oak seedling growth

50 to 100% full sunlight maximum growth

White oak → Scarlet oak

Intermediate — Intolerant

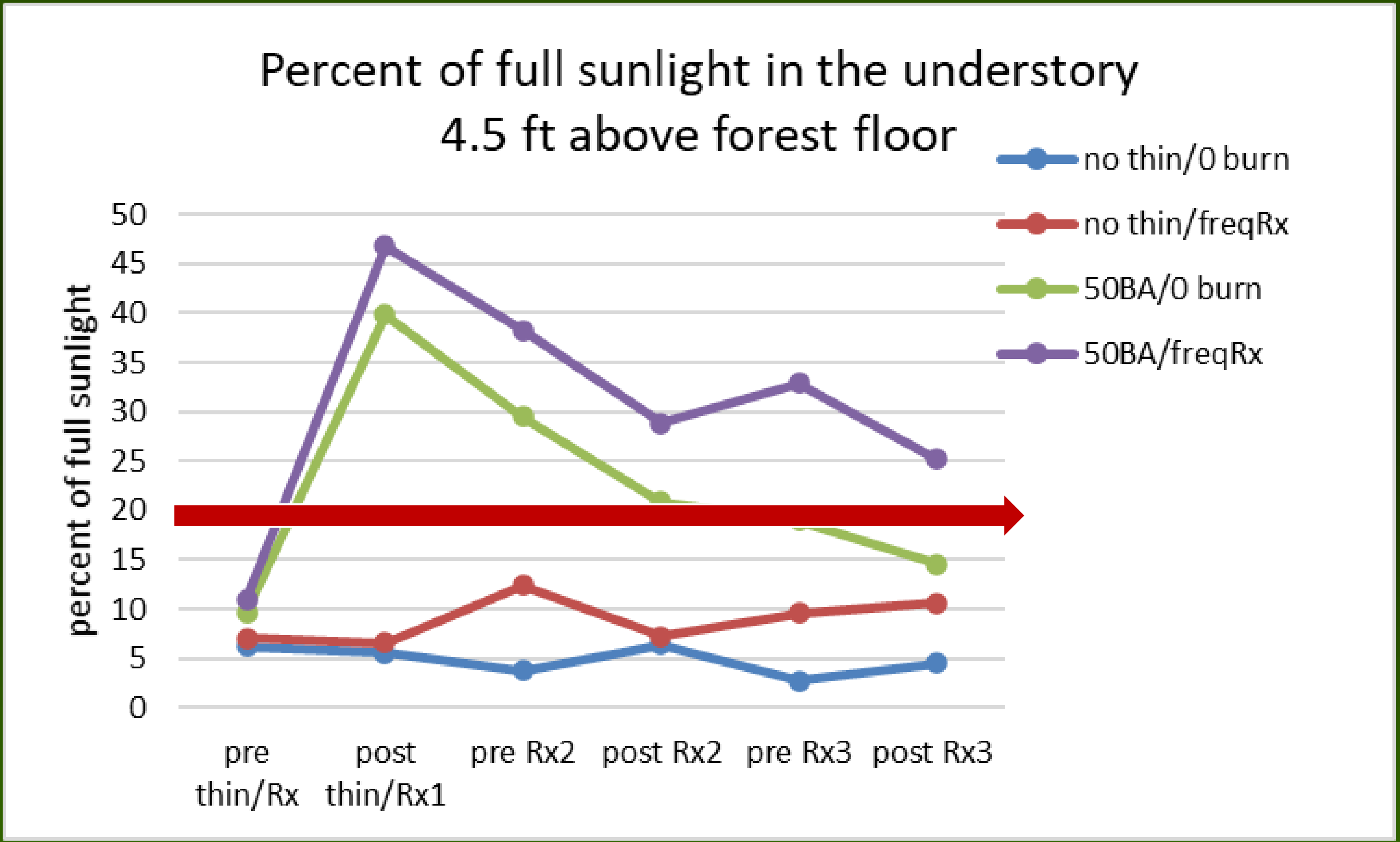
Shade Tolerance

Cumberland Plateau, Bankhead NF, AL
Mixed pine-upland hardwood forests
Using thinning and burning
Move stands towards oaks

THE CONUNDRUM OF CREATING UNDERSTORY LIGHT CONDITIONS CONDUCIVE TO PROMOTING OAK REPRODUCTION: MIDSTORY HERBICIDE AND PRESCRIBED FIRE TREATMENTS

Callie Jo Schweitzer and Daniel C. Dey[1]

Citation for proceedings: Holley, A. Gordon; Connor, Kristina F.; Haywood, James D., eds. 2015. Proceedings of the 17th biennial southern silvicultural research conference. e–Gen. Tech. Rep. SRS–203. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 551 p.



Fire by itself is a mediocre means to increase understory light

To recruit oak, make growing space

Introduce a series of disturbances which may include fire

Grow small oak into more competitive positions

- Regeneration is a process
  - Shelterwood
  - Seedtree with reserves
  - Two-aged stands

Plus fire?

Meta analysis of prescribed fire and oak

Brose et al. 2013

Multiple fires cause a reducti
and pole densities

Oaks and mesophytic species

Prescribed fire did not change
of oak reproduction

Three dormant season fires w
equal the impact of one grow

Residual tree damage concer

A Meta-Analysis of the Fire-Oak Hypothesis: Does Prescribed Burning Promote Oak Reproduction in Eastern North America?

Patrick H. Brose, Daniel C. Dey, Ross J. Phillips, and Thomas A. Waldrop

Abstract: The fire-oak hypothesis asserts that the current lack of fire is a reason behind the widespread oak (*Quercus* spp.) regeneration difficulties of eastern North America, and use of prescribed burning can help solve this problem. We performed a meta-analysis on the data from 32 prescribed fire studies conducted in mixed-oak forests to test whether they supported the latter assertion. Overall, the results suggested that prescribed fire can contribute to sustaining oak forests in some situations, and we identified several factors key to its successful use. Prescribed fire reduced midstory stem density, although this reduction was concentrated in the smaller-diameter stems. Prescribed fire preferentially selected for oak reproduction and against mesophytic hardwood reproduction, but this difference did not translate to an increase in the relative abundance of oak in the advance regeneration pool. Fire equalized the height growth rates of the two species groups. Establishment of new oak seedlings tended to be greater in burned areas than in unburned areas. Generally, prescribed burning provided the most benefit to oak reproduction when the fires occurred during the growing season and several years after a substantial reduction in overstory density. Single fires conducted in closed-canopy stands had little impact in the short term, but multiple burns eventually did benefit oaks in the long term, especially when followed by a canopy disturbance. Finally, we identify several future research needs from our review and synthesis of the fire-oak literature. FOR. SCI. 59(3):322–334.

Keywords: fire effects, hardwoods, prescribed fire, *Quercus* spp., shelterwood

THROUGHOUT EASTERN NORTH AMERICA, mixed-oak (*Quercus* spp.) forests on upland sites are highly valued for many ecological and economic reasons. Generally, these upland forests consist of one or more oak species (black [*Quercus velutina* Lam.], chestnut [*Quercus montana* Willd.], northern red [*Quercus rubra* L.], scarlet [*Quercus coccinea* Muenchh.], and white [*Quercus alba* L.]) dominating the canopy with a mix of other hardwood species in the midstory and understory strata. Despite widespread abundance and dominance of mixed-oak forests, regenerating them is a chronic challenge for land managers throughout eastern North America and they are slowly being replaced by mesophytic hardwoods such as black birch (*Betula lenta* L.), black cherry (*Prunus serotina* Ehrh.), red maple (*Acer rubrum* L.), sugar maple (*Acer saccharum* Marsh.), and yellow-poplar (*Liriodendron tulipifera* L.) (Abrams and Downs 1990, Healy et al. 1997, Schuler and Gillespie 2000, Aldrich et al. 2005, Woodall et al. 2008). Many factors contribute to this oak regeneration problem including loss of seed sources, destruction of acorns and seedlings by insects, disease, weather, and wildlife, dense understory shade, competing vegetation, and lack of periodic fire (Crow 1988, Loftis and McGee 1993, Johnson et al. 2009). The implication of the lack of periodic fire as a cause to the oak regeneration problem arises from the fact that many of these oak forests exist, in part, due to past fires, and this relationship has led to the creation of the fire-oak hypothesis (Abrams 1992, Lorimer 1993, Brose et al. 2001, Nowacki and Abrams 2008, McEwan et al. 2011).

The fire-oak hypothesis consists of four parts: (1) periodic fire has been an integral disturbance in the mixed-oak forests of eastern North America for millennia; (2) oaks have several physical and physiological characteristics that allow them to survive at higher rates than their competitors in a periodic fire regime; (3) the lack of fire in the latter 20th century is a major reason for the chronic, widespread oak regeneration problem; and (4) reintroducing fire via prescribed burning will promote oak reproduction. The first three parts are supported by the scientific literature to various degrees. For example, paleo-ecological studies and historical documents indicate that American Indian tribes used fire for numerous reasons (Day 1953, Wilkins et al. 1991, Patterson 2006, Ruffner 2006). Many studies reported the differences between oaks and mesophytic hardwood species (Gottschalk 1985, 1987, 1994, Kolb et al. 1990), and the concomitant decline of fire and increase in mesophytic hardwoods during the early 1900s is evident from fire history research (Shumway et al. 2001, Guyette et al. 2006, Hutchinson et al. 2008, Aldrich et al. 2010). It remains hard to verify the fourth part of the fire-oak hypothesis—that

Manuscript received April 3, 2012; accepted July 17, 2012; published online August 16, 2012; http://dx.doi.org/10.5849/forsci.12-039.

Patrick H. Brose (pbrose@fs.fed.us), USDA Forest Service, Northern Research Station, Irvine, PA. Daniel C. Dey (ddey@fs.fed.us), USDA Forest Service. Ross J. Phillips (rjphillips@fs.fed.us), USDA Forest Service. Thomas A. Waldrop (twaldrop@fs.fed.us), USDA Forest Service.

Acknowledgments: We thank the many fellow scientists who stimulated our thinking on this subject via engaging conversations as well as by sharing insights on the details of their studies, especially data collection procedures, and pointing us toward publications that had escaped our searches. We thank Alejandro Royo, John Stanovick, and Matthew Trager for guidance with the meta-analysis. In addition, we thank them and three anonymous individuals for reviews of earlier drafts of this article that helped with clarity and conciseness. Funding for this study was provided by the Joint Fire Science Program (Project 10-2-01-1).

This article was written and prepared by a US Government employee on official time, and is therefore in the public domain and not subject to US copyright protection.

Fire Ecology Volume 12, Issue 2, 2016
doi: 10.4996/fireecology.1202085

Research Article

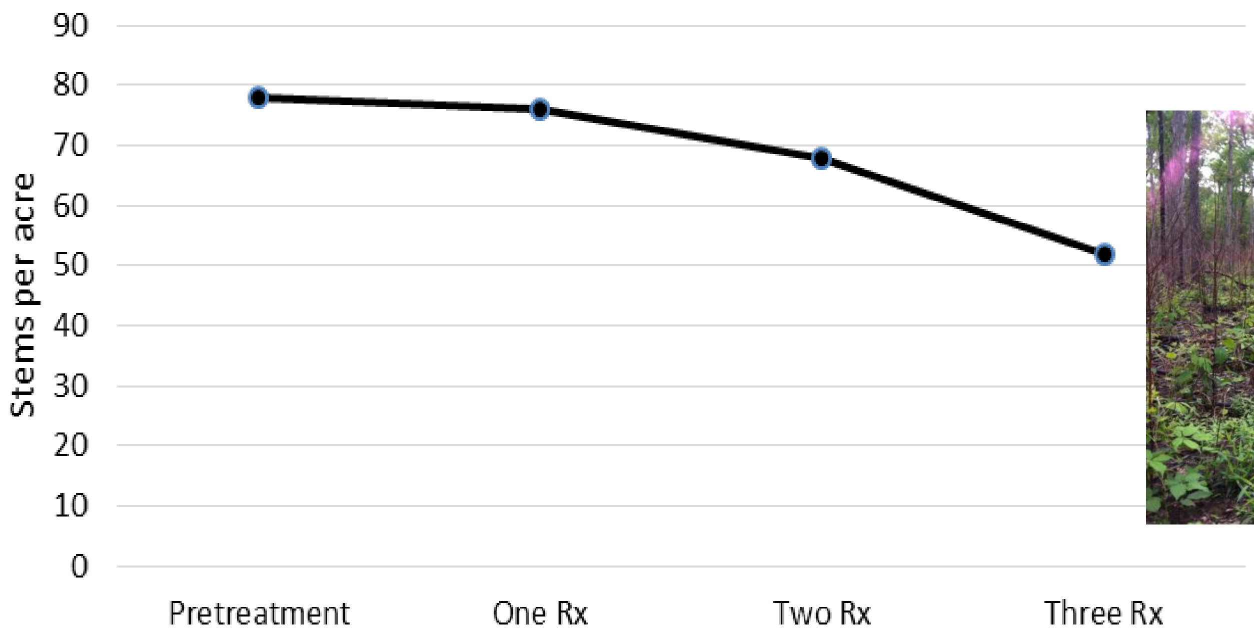
Hardwood-Pine Mixedwoods Stand Dynamics following Thinning and Prescribed Burning

Callie Jo Schweitzer[1*], Daniel C. Dey[2], and Yong Wang[3]

[1*] USDA Forest Service, 730 D Cook Avenue, Huntsville, Alabama 35801, USA

[2] USDA Forest Service, University of Missouri,
202 Natural Resources Building, Columbia, Missouri 65211, USA

Decline in density for 1.6-4.0" dbh stems, oaks, after 1, 2 and 3 prescribed burns on the William B. Bankhead National Forest, AL



Prescribed fire and oak

Site preparation by burning-

Reduced litter readily accumulates
Germination not always an issue
*recruitment is

Oak seedlings depend on acorns
Acorns can be killed by fire
Acorn production is sporadic
Oak germinants susceptible to fire

Can decrease midstory density
Often a long-term endeavor

Red maple drops seeds late spring

Prescribed fire and oak

Recruitment by burning

must have reproduction present
need to increase understory light
requires multiple fires
indiscriminate top-kill
there will be lots of sprouting

Alternatives

reduce midstory shade and competition by herbicide
recruit oaks
herbicided competitors are dead=no sprouts

Shelterwood phase I to reduce overstory 45-65 BA residual
burn after oaks establish bigger roots

Shelterwood Burn Prescription
VA Piedmont, upland oak forest
Cut to 57 ft^2/a
Burned 4 growing seasons after harvest
One burn each season
Multiple stems from a rootstock counted as one

ELSEVIER

Forest Ecology and Management 113 (1999) 125-141

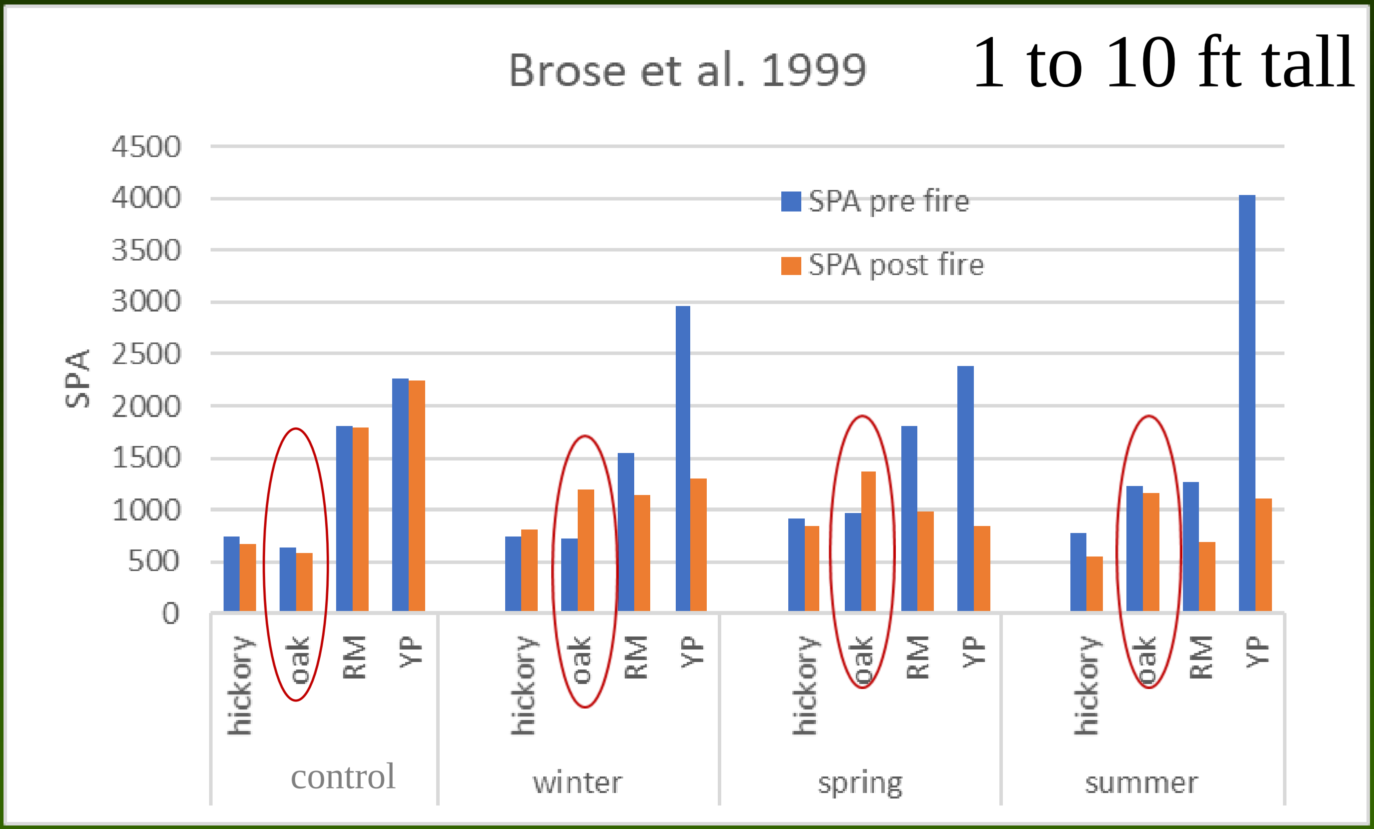
Forest Ecology and Management

Using shelterwood harvests and prescribed fire to regenerate oak stands on productive upland sites

Patrick Brose[1,*], David Van Lear[2], Roderick Cooper'

[1] USDA Forest Service. 233 Lehotsky Hall. Clemson University Clemson SC 29634-1003, USA
[2] Department of Forest Resources. 261 Lehotsky Hall. Clemson University Clemson SC 29634-1003. USA

Received 13 April 1998: accepted 18 June 1998




Forest Ecology and Management 260 (2010) 1516–1524
Contents lists available at ScienceDirect
Forest Ecology and Management
journal homepage: www.elsevier.com/locate/foreco

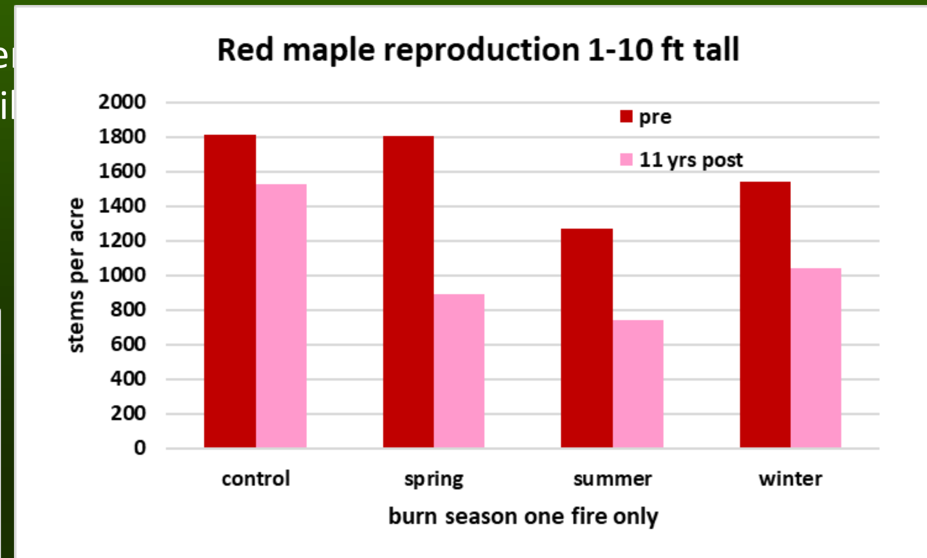
Long-term effects of single prescribed fires on hardwood regeneration in oak shelterwood stands

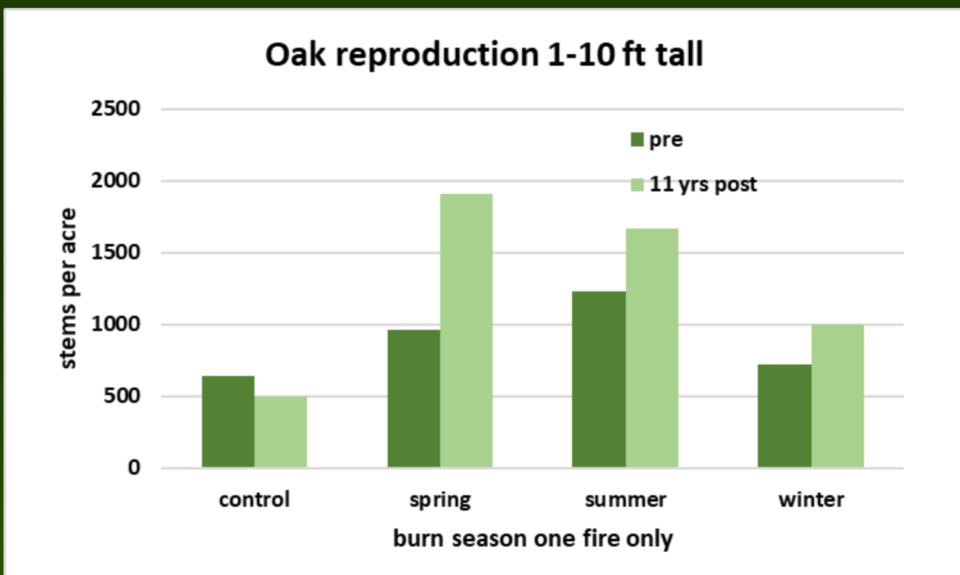
Patrick H. Brose*
USDA Forest Service, Northern Research Station, 335 National Forge Road, Irvine, PA 16329, USA

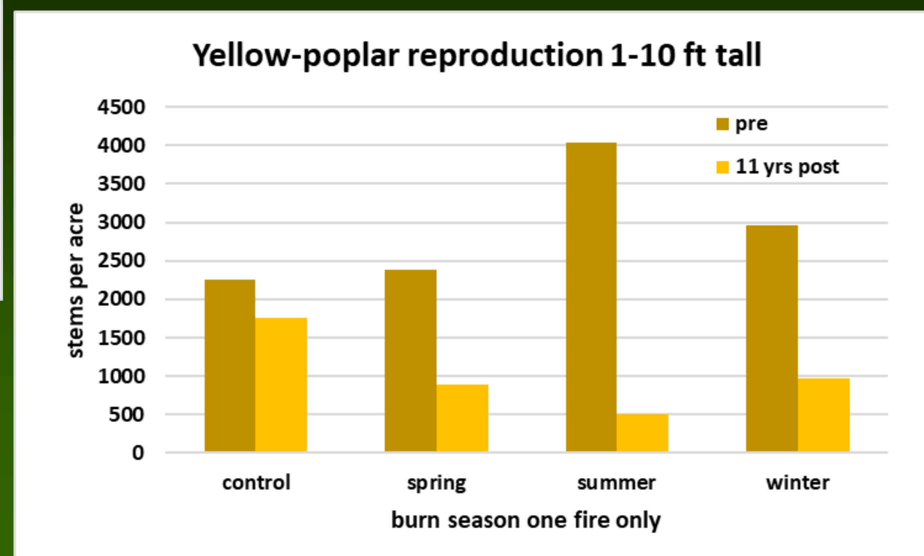
Fire improves species composition of reproduction but this is temporary

Need multiple fires

After
April







Blue Ridge, Pisgah NF, NC
Upland hardwood forests
Dormant season burn March
Growing season burn April


Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Season of burn effects on vegetation structure and composition in oak-dominated Appalachian hardwood forests

Tara L. Keyser, Cathryn H. Greenberg, W. Henry McNab

USDA Forest Service, Southern Research Station, Bent Creek Experimental Forest, 1577 Brevard Rd., Asheville, NC 28806, USA

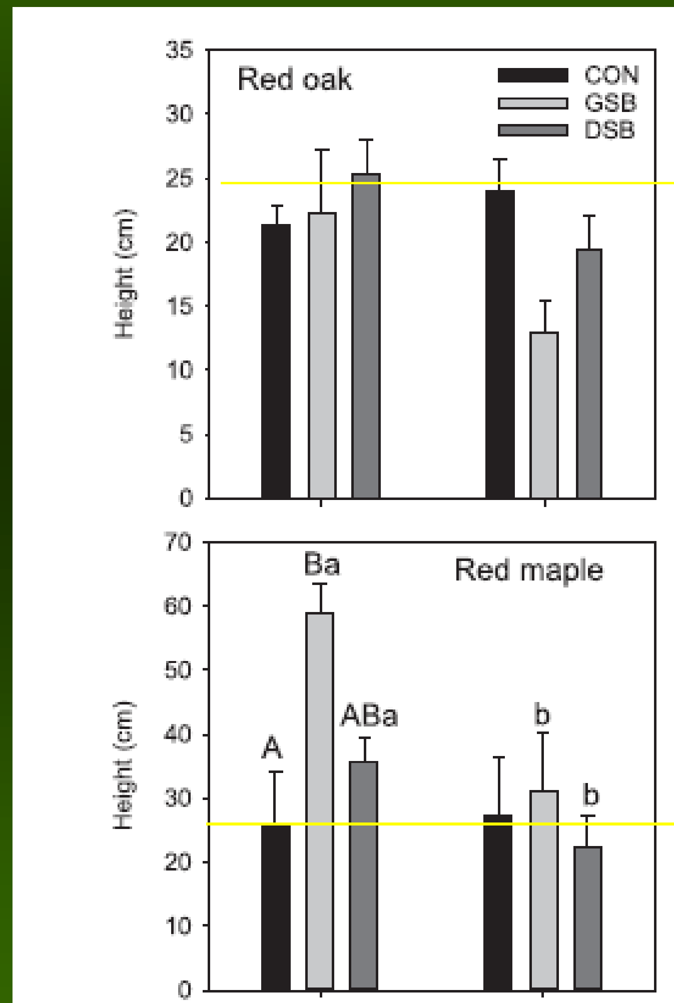
3 years POST burn:

Seedlings densities

Red maple
Red oak and
White oak

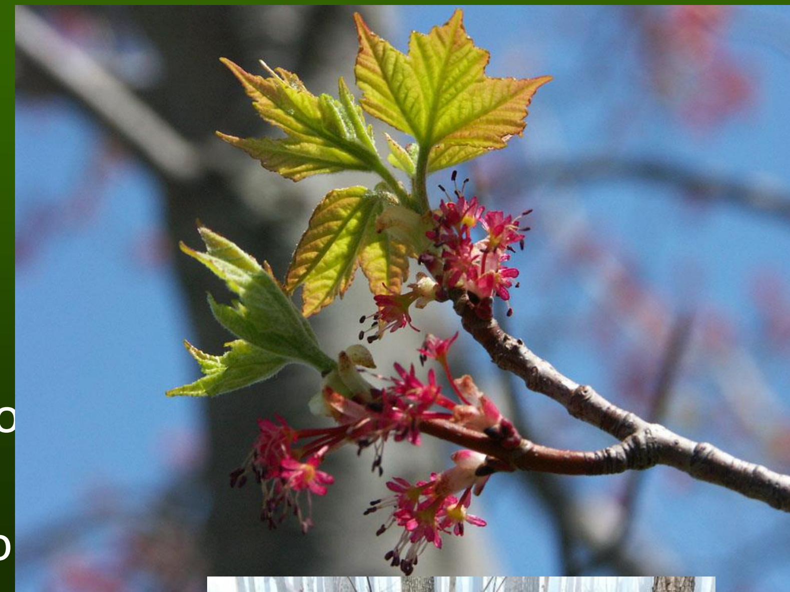
did not differ
between burn season

Red maple has a height advantage



Pre burn   Post burn

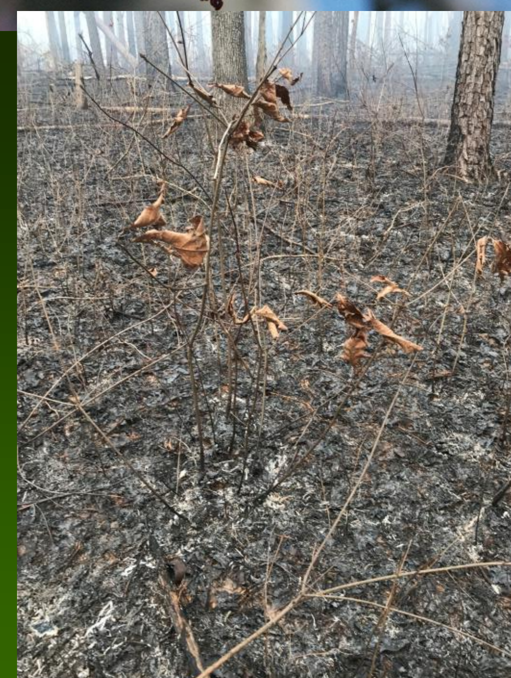
When to do it: Prescribed fire and oak recruitment



Can burn after the initial shelterwoo
harvest
OR wait a few years to allow oaks to
carbon to roots
OR burn ***when you can to get it in***

Assess the stocking of your oaks
– what would fire buy?

Timing- bud burst of competitors



Cumberland Plateau, Bankhead NF, AL
Mixed pine-upland hardwood forests
Using thinning and burning
Move stands towards oaks

APPLIED RESEARCH

For. Sci. XX(XX):1–9
doi: 10.1093/forsci/fxz031
Published by Oxford University Press on behalf of the Society of American Foresters 2019.
This work is written by (a) US Government employee(s) and is in the public domain in the US.

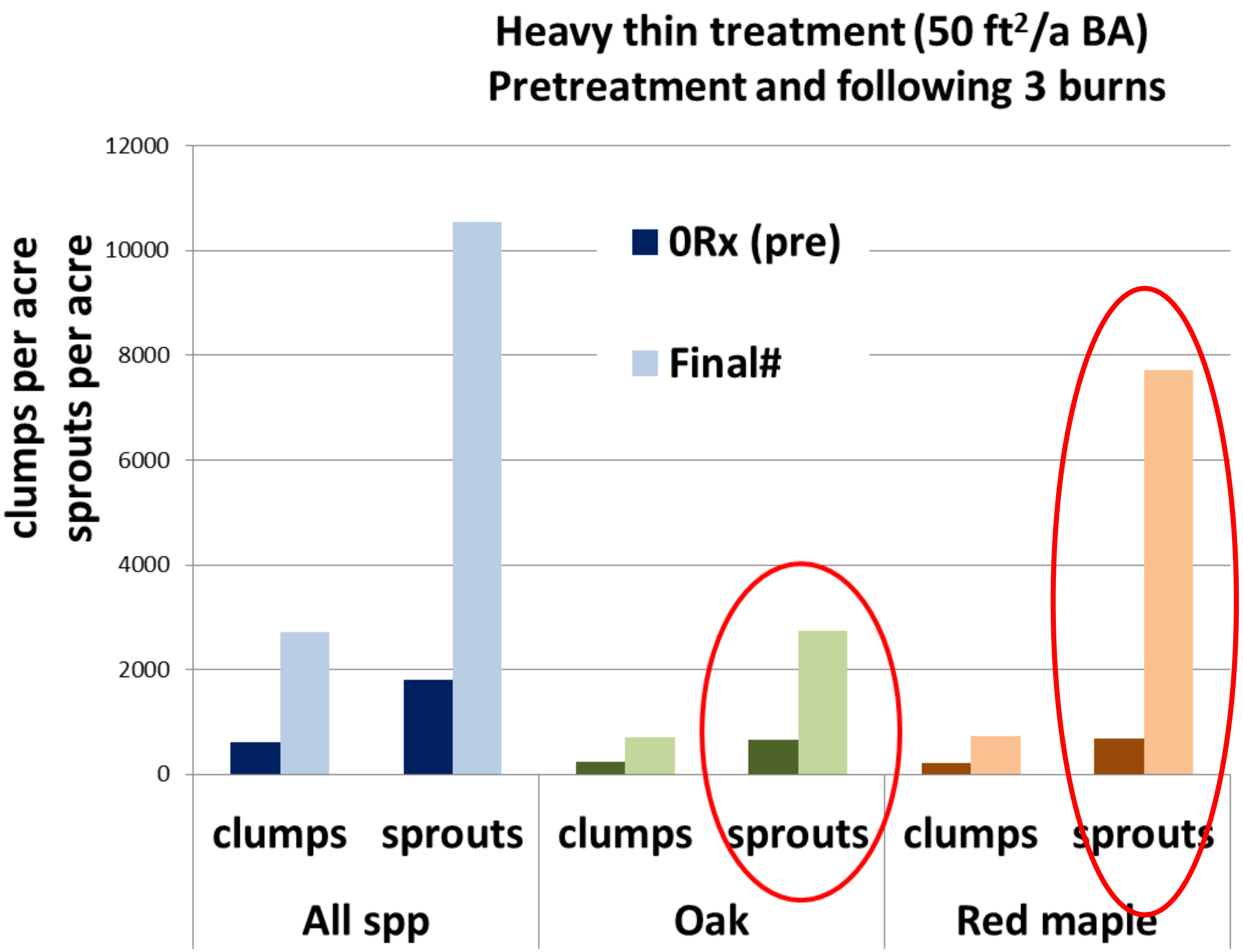
forest management

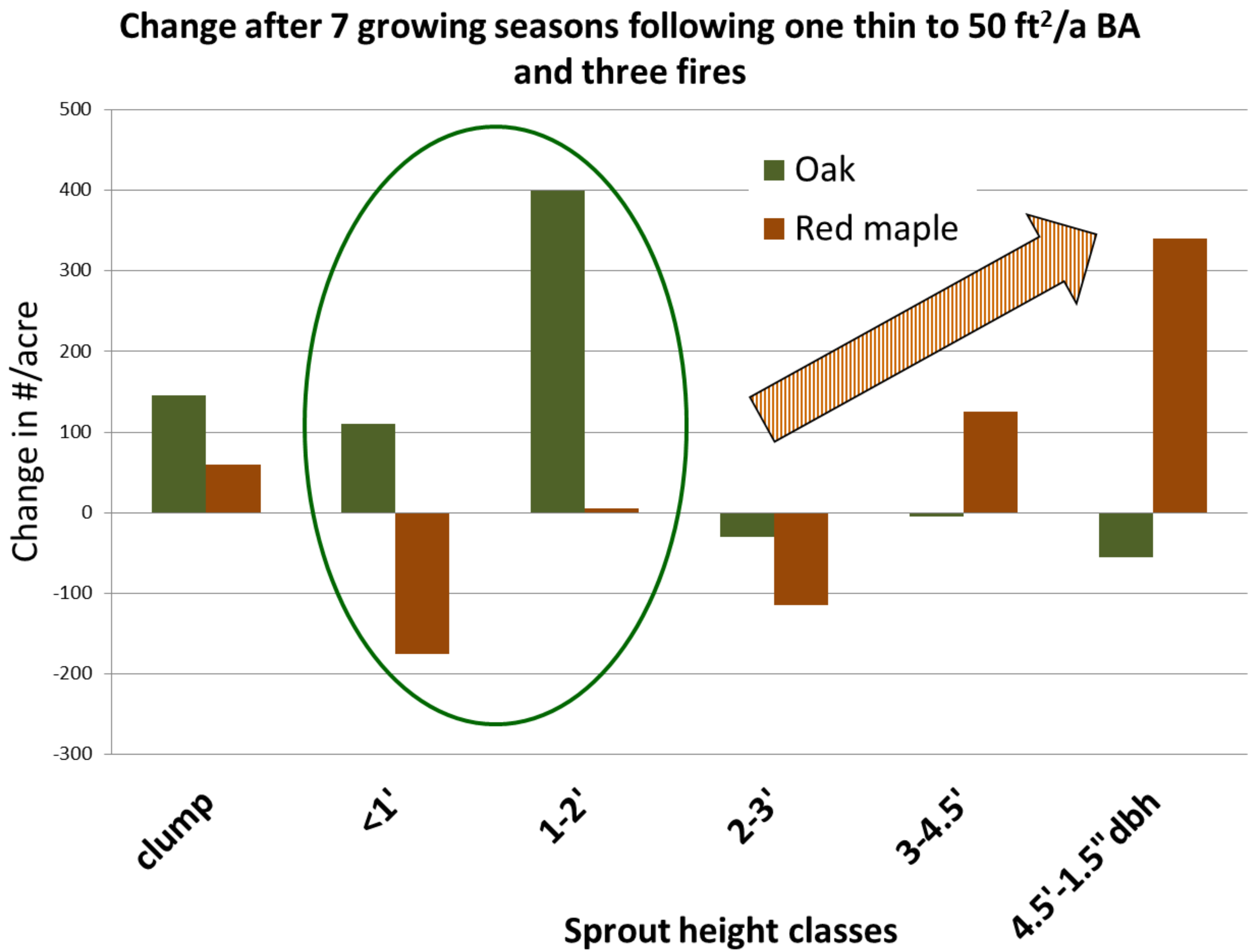
White Oak (*Quercus alba*) Response to Thinning and Prescribed Fire in Northcentral Alabama Mixed Pine–Hardwood Forests

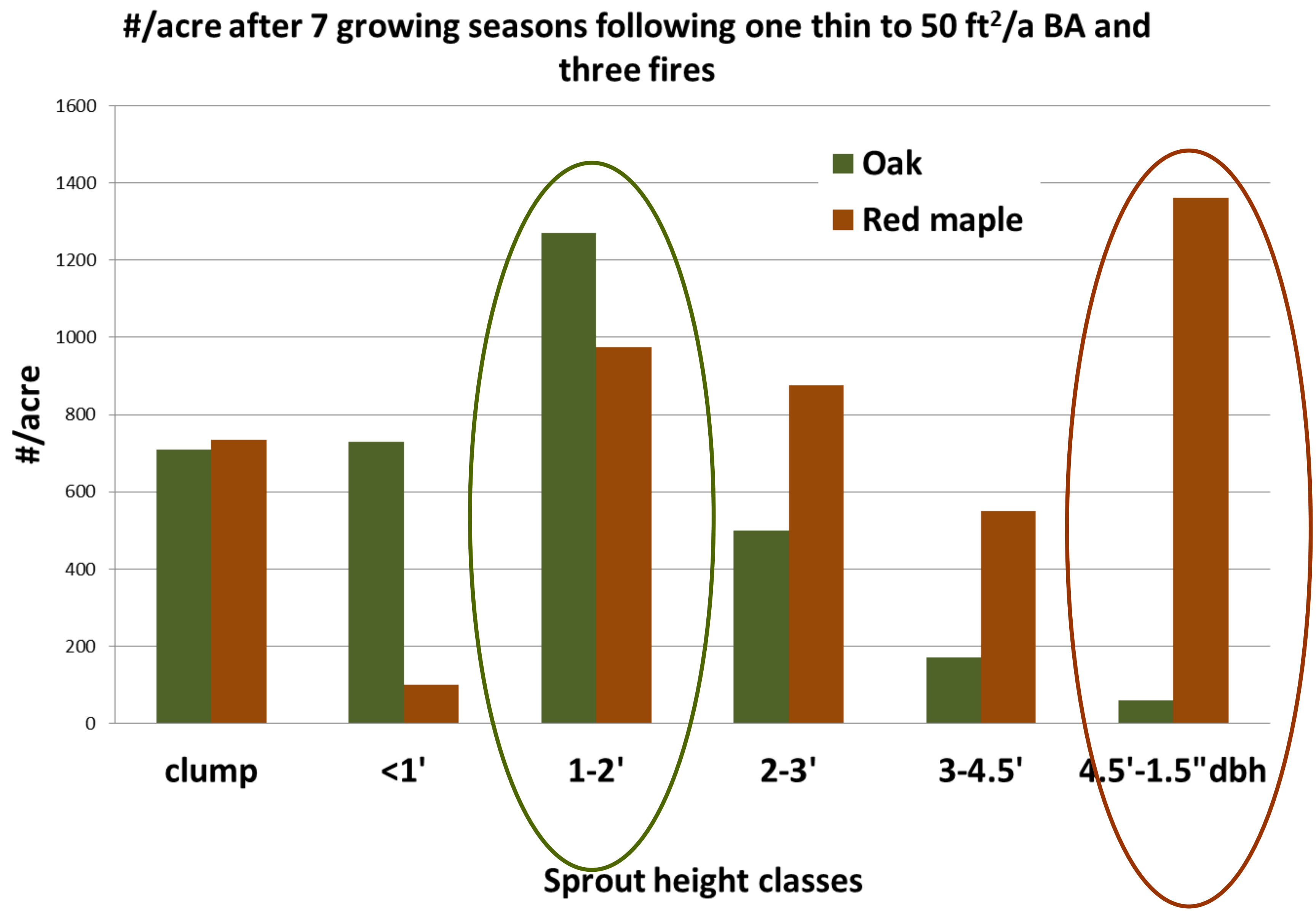
Callie J. Schweitzer, Daniel C. Dey, and Yong Wang

	Harvest	Burn 1	Burn 2	Burn 3	Burn 4	Burn 5	Burn 6
Block 1	Summer 2005	Winter 2006	Winter 2009	Winter 2012	Winter 2015	Winter 2018	Winter 2021
Block 2	Summer 2006	Winter 2007	Winter 2010	Winter 2013	Winter 2016	Winter 2019	Winter 2022
Block 3	Summer 2006	Winter 2007	Winter 2010	Winter 2013	Winter 2016	Winter 2019	Winter 2022
Block 4	Summer 2007	Winter 2008	Winter 2011	Winter 2014	Winter 2017	Winter 2020	Winter 2023

Bankhead NF thin and burn study: reproduction >1 ft tall up to 1.5” dbh




Change after 7 growing seasons following one thin to 50 ft²/a BA and three fires
Oak
Red maple
Change in #/acre
500
400
300
200
100
0
-100
-200
-300
clump
<1'
1-2'
2-3'
3-4.5'
4.5'-1.5" dbh
Sprout height classes


#/acre after 7 growing seasons following one thin to 50 ft²/a BA and three fires
1600
1400
1200
1000
800
600
400
200
0
#/acre
Oak
Red maple
clump
<1'
1-2'
2-3'
3-4.5'
4.5'-1.5"dbh
Sprout height classes

Limited burning windows

Timing may be the answer:

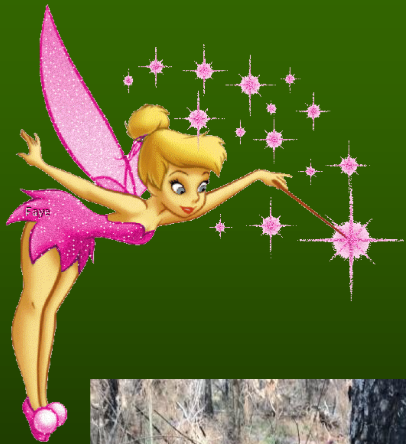
Hit the understory with the hottest fire allowable when undesirables are budding out

Pluralism of prescribed fire: seasonality, intensity, thinning

- Phases: First: Shelterwood/thinning
- Phases: Second: Remove overstory
- Treat understory before harvest? After harvest?

Red maple

Oaks



Release burning

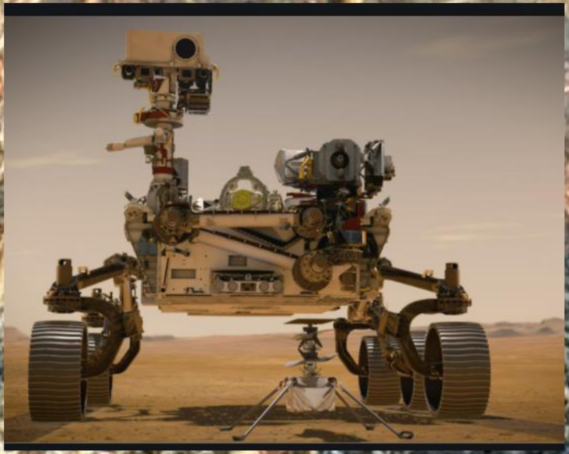
- Stand at end of oak regeneration process
- Size and numbers of oak adequate
- Hot spring burn when mesophytics are 50% leafed out and oaks are still dormant
- Challenges

Prescribed Fire is Not Magic Pixie Dust!

-Stephen Pyne

- Fire as a process vs a tool
- Don’t use it because you ‘have to’ burn
  - Fire should not drive silvicultural decisions
- Pluralism: Timing, frequency, intensity
- Mixed outcomes- oak reproduction
- Site drivers: stand/landscape, mesic, xeric, prior disturbance, current status
- Future timber quality
- Planning and policy concerns
- There are reasons to burn other than oak recruitment
  - Herbaceous understory
  - Woodlands/savannahs
  - Insect diversity
  - Wildlife habitat
  - Fuels reduction

Prescribed Fire's Place in Oak Regeneration



Callie Schweitzer
Research Forester
USFS Southern Research Station